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Underground nuclear test activities in the United States and the Soviet Union from 1969 to 1973

1. The aim of this working paper is to report on the recent test-activities in the United States and the Soviet Union and to discuss the estimated yields of these explosions in relation to the threshold of 150 kt agreed upon in the treaty on the limitation of underground nuclear weapon tests. The number of announced, or by seismological means detected, underground explosions in the two countries during the years 1969-1973 is presented here below, together with yield estimates based on generally available seismological data.

2. The United States has, according to official announcements, carried out 86 underground nuclear explosions during these five years. Three of these explosions were announced as a part of the Plowshare project for peaceful uses of nuclear explosions. The yields and positions of these peaceful explosions have been released. Eighty-one of the remaining explosions have been conducted at Nevada Test Site and two on Amchitka Island. Seismometric data have been obtained and reported from all 86 explosions. Such data also indicate that at least 18 more explosions, which were not officially announced by the United States have been carried out at Nevada Test Site, thereby bringing the total number of explosions in the United States to at least 104 in 1969-1973.

3. The Soviet Union has not officially announced any nuclear explosion in the years 1969 to 1973. The United States Atomic Energy Commission has announced 56 underground nuclear explosions as having been carried out in the Soviet Union during this time. Seismometric data have been reported from these explosions and such data also indicate that in addition to explosions announced by the United States Atomic Energy Commission another 26 underground explosions have been carried out in the Soviet Union during these five years. Fifty-four of the total 82 Soviet explosions have been in test sites in Kazakhstan and on Novaya Zemlya. The remaining 28 explosions occurred in different places, mainly in the Western parts of the Soviet Union and in the Caspian and Black Sea regions. Because of their locations these explosions are here taken to be part of a Soviet programme for peaceful uses of nuclear explosions.

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4. The yield estimates are based mainly on seismometric short period amplitude and period data, reported from globally distributed stations. For a few recent events long period seismic data have been supplemented. The availability of calibration explosions, for which explosion yields and geophysical parameters of the explosion media are announced, is of crucial importance for an accurate yield determination. The availability of calibration explosions is foreseen in the recent threshold test ban treaty, through an exchange of calibration explosion data for each test site. The lack today of such calibration severely limits the accuracy of yield estimates. The need for such calibration explosions is greatest for test sites in the Soviet Union, as no yields whatsoever have been officially announced for the explosions there.

5. The United States has officially announced the yields of 12 underground nuclear explosions at Nevada Test Site in 1966 to 1968, with yields large enough to be observed at an adequate number of seismometric stations. These explosions were used as calibration explosions for estimating the yields of the Nevada Test Site explosions. Yields and other source data have also been published for two large chemical explosions in the Alma-Ata region of the Soviet Union and for two underground nuclear explosions for peaceful purposes in Uzbekistan. These four explosions were used as calibration explosions when estimating the yields of the Soviet explosions. These calibration explosions were, however, not located in any of the Soviet test sites. As the test sites and the other peaceful explosions were distributed over a very large area, considerable systematic uncertainty must be assigned to the yield estimates of the Soviet explosions.

6. The yields of the explosions at Nevada Test Site and at the Soviet test site in Kazakhstan have been estimated by a method described in a scientific report "Seismic source and transmission functions for underground nuclear explosions with known yields at Nevada Test Site", referred to in the Swedish working paper CCD/405. In the present computations more than 2,000 observations from nearly 100 seismometric stations were used. The yield estimates range by a factor of more than 1,000, from about 1 kt to more than 1 Mt. The yields of the Soviet explosions outside the Kazakhstan test site were estimated using an m_b (NOAA)-yields relation obtained from the Kazakhstan explosions and the M_s-yield relation reported in the scientific paper "Surface waves from underground explosions", reproduced in the United Kingdom working paper CCD/363/Rev.1, employing M_s observations at the Hagfors observatory in Sweden.

7. The detailed results will be published elsewhere and are only summarized here in table 1. It shows the number of explosions whose yields can be estimated with high confidence to be above respectively below the 150 kt threshold, and also the number of explosions for which reliable statement about the yield is not possible with the present data. This category is considerably larger for the Soviet than for the American explosions. The table shows that most of the explosions appeared to be well below 150 kt and that only a small fraction of them appeared to be above 150 kt.

8. Improvements of the present estimates should become possible, when the results of the yield calibration of test sites, as foreseen in the recent threshold test ban treaty between the United States and the Soviet Union are made available.

Table 1

Summary of estimated yields of underground explosions in the United States and Soviet Union in 1969-1973

	United States			Soviet Union		
	peaceful	weapons tests	all tests	peaceful yy/	at test sites	all sites
Stronger than 150 kt	-	7	7	-	8	8
Around 150 kt x/	-	8	8	5	8	13
Weaker than 150 kt	3	86	89	23	38	61

x/ This line shows the number of explosions for which available seismometric data did not permit confident statements on whether they had yields below or above 150 kt.

y/ The events in this column are listed as peaceful because they occurred in places other than the two main test sites.